

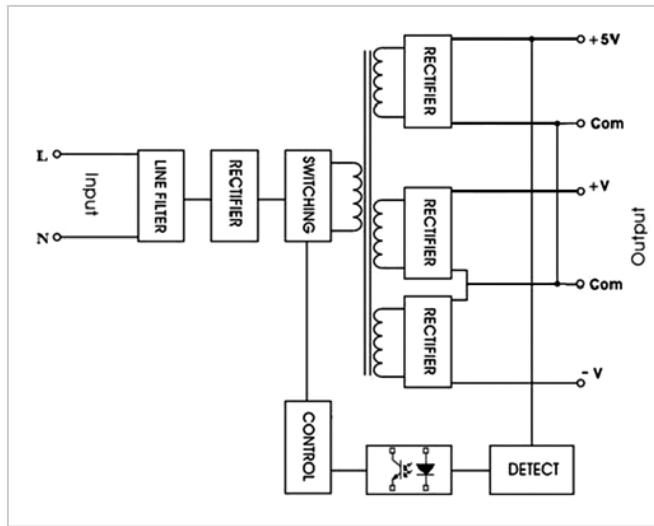
Monday, April 9, 2012

Minimum loads and cross-regulation on multiple output power supplies

One subject that our Technical Support team frequently gets asked about is minimum loads on multiple output power supplies, so I thought this would be a good subject to write about.

On a low cost, low power, multiple output power supply, the datasheet will often state that to maintain regulation, a minimum load has to be applied to one or more of the outputs.

To explain why, here is a block diagram of one such simple triple output power supply.



On the middle right hand side of the diagram are the three output windings from the transformer.

On Channel 1 (+5V), the output from the transformer is rectified and filtered to provide a smooth, DC output. If that output voltage is not at the set voltage, say due to a load change, the power supply will automatically correct itself. It does this by sensing the output voltage, comparing it to an internal reference, and feeding back a signal to the control circuit via the opto-coupler. The control circuit will then adjust the pulse width of the converter accordingly. The regulation on this output is typically 1 to 2%.

On Channels 2 & 3 (+V and -V) though, it can be seen that there is no feed back to the control circuit. These outputs are referred to as "semi-regulated". If Channel 2's load were to increase for example, the output would drop slightly, but there would not be any automatic correction. That voltage drop is specified by the load regulation specification, typically 3 to 5%.

With respect to minimum loading, if there is little or no load on Channel 1, the output will still be at the set voltage, but the switching converter pulse width will be very narrow. The output voltage on Channels 2 & 3 drops fairly dramatically at those narrow pulse widths, particularly if the outputs are supplying their full rated load. An output voltage of 12V may drop to 8V.

Conversely, if the full rated load is applied to Channel 1, but Channels 2 & 3 are not loaded, the voltages on 2 & 3 will rise, and a 12V output could deliver over 14V.

The effect that varying loads on Channel 1 has on the "semi-regulated," Channels 2 & 3, is many times referred to as the "cross regulation" specification.

Manufacturers of power supplies specify a minimum load requirement on Channel 1, usually 10%, to warn the user. Minimum loads may also be specified on Channels 2 & 3 to promote a better regulation specification.

Operating without a minimum load will not normally cause a power supply to fail, but can stress the user's equipment.

Some products like TDK-Lambda's MTW series employ two converters to improve power supply regulation, one to supply Channel 1 & one to supply Channels 2 & 3. Note that both V2 and V3 are sensed by the control circuit.

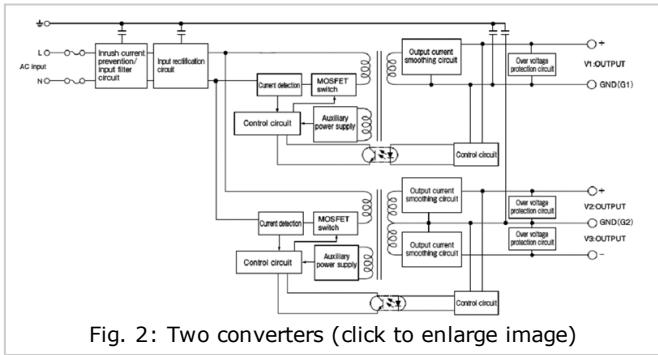


Fig. 2: Two converters (click to enlarge image)

Here is a link for more details about the MTW series: <http://www.us.tdk-lambda.com/lp/products/mtw-series.htm>

Other products like the NV175 series employ post regulators on each output, completely eliminating the minimum load requirement. Although this does add cost to the power supply, it removes any concern for the user and helps with system flexibility. Here is a link to the datasheet for NV175 series: <http://www.us.tdk-lambda.com/lp/ftp/Specs/nv175.pdf>

Posted by [Power Guy](#)